

Claims

What is claimed is:

- 1 1. A method of treating vascular tissue, the method comprising:
 - 2 a. locating a target area of the vascular tissue; and
 - 3 b. delivering laser radiation to the target area, the laser radiation comprising a
 - 4 sequence of laser bursts, wherein each laser burst comprises a plurality of laser
 - 5 pulses having laser fluences sufficient to cut the vascular tissue while controlling
 - 6 hemorrhaging.
- 1 2. The method of claim 1, wherein the laser bursts are repeated at a repetition rate of 5.0
- 2 KHz or less.
- 1 3. The method of claim 1, wherein the repetition rate is in a range of 10 to 40 Hz.
- 1 4. The method of claim 1, wherein the laser fluences are in a range of 1.0 to 10 J/cm².
- 1 5. The method of claim 1, wherein the laser fluences are in a range of 2.0 to 7.0 J/cm².
- 1 6. The method of claim 1, wherein laser bursts comprises 1-24 pulses.

- 2 7. The method of claim 6, wherein the laser pulses are separated by less than 2.0
3 milliseconds.
- 1 8. The method of claim 7, wherein the laser pulses are separated by a 0.01 and 1.25
2 milliseconds.
- 1 9. The method of claims 8, wherein the laser pulses have pulse widths of less than 100
2 microseconds.
- 1 10. The method of claim 9, wherein the laser pulses have pulse widths in a range of 65 to 95
2 microseconds.
- 1 11. The method of claim 1, wherein the laser radiation is delivered to the target area with
2 exposure spot sizes of less than 500 microns.
- 1 12. The method of claim 11, wherein the exposures spots sizes are in a range of 50 to 225
2 microns.
- 1 13. The method of claim 12, wherein the laser radiation has a penetration depth through
2 aqueous saline medium of less than 1.5 mm.

- 3 14. The method of claim 13, wherein the ratio of the exposure spot sizes to the penetration
4 depth is less than 10.
- 1 15. The method of claim 1, wherein the laser radiation comprises laser radiation having a
2 wavelength of 2.94 microns and with an energy in a range of 5-200 mJ per bursts.
- 1 16. The method of claim 1, wherein the vascular tissue corresponds vascular ophthalmic
2 tissue.
- 1 17. The method of claim 16, where locating the target tissue comprises:
2 a. determining a relative separation between a fibrous membrane or a fibro-vascular
3 membrane and a retinal surface; and
4 b. selecting a approach angle for cutting the fibrous vascular tissue such that the
5 laser radiation does not significantly penetrate the retinal tissue at the retinal
6 surface.
- 1 18. The method of claim 17, wherein the laser radiation is delivered to the ophthalmic tissue
2 at a controlled distance from the retinal surface.
- 1 19. A laser system comprising:

- 2 a. a laser source for generating laser light comprising laser bursts comprising laser
3 pulses; and
4 b. a laser applicator for delivering a portion of the laser light to vascular tissue, such
5 that the laser light cuts the vascular tissue without causing significant
6 hemorrhaging.

1 20. The system of claim 19, wherein the laser source is configured to generate laser light with
2 energy corresponding to between 1 and 200 mJ/per pulse.

1 21. The system of claim 19, wherein the laser source is configured to generate the laser bursts
2 with a repetition rate of between 40 and 10 Hz.

1 22. The system of claim 19, wherein the laser source is configured to generate the laser bursts
2 with a separation of less than 2.0 milliseconds.

1 23. The system of claim 19, wherein the laser burst comprises 1-24 laser pulses.

1 24. The system of claim 22, the laser pulses are separated by less than 2.0 milliseconds.

1 25. The system of claim 23, wherein pulses have pulse widths of less than 100 microseconds.

- 1 26. The system of claim 18, wherein the laser applicator comprises a flexible optical fiber
2 with a firing end having a diameter of less than 500 microns.
- 1 27. The system of claim 26; wherein the optical fiber is selected from the group consisting of
2 fused silica fiber and a sapphire fiber.
- 1 28. The system of claim 26, wherein the applicator further comprises structure for shielding
2 unwanted laser light from the vascular tissue.
- 1 29. The system of claim 26, wherein the applicator further comprises means to control a
2 distance of the firing end from the vascular tissue.
- 1 30. The system of claim 29, wherein the means to control the distance of the firing end from
2 the vascular tissue is a shroud structure.
- 1 31. The system of claim 19, wherein applicator is flexible allowing the laser light to be
2 delivered to the vascular tissue at a range of approach angles.
- 1 32. A laser system comprising:

- 2 a. means to generate bursts of laser light comprising laser pulses;
- 3 b. means to focus the laser light into a trunk optical fiber; and
- 4 c. flexible endo-probe coupled to the trunk optical fiber, the endo-probe comprises a
- 5 delivery optical fiber with an input end for receiving laser radiation from the
- 6 truck fiber and a firing end for exposing a target area of vascular tissue, wherein
- 7 the target area of vascular tissue is located within the cavity of a body.

1 33. The laser system of claim 32, wherein the flexible endo-probe comprises guide structures

2 through which the delivery fiber extends, wherein guide structure is configured be bent

3 and to guide the firing edge of the delivery optical fiber at preferred angles relative to the

4 target area of the vascular tissue.

1 34. The laser system of claim 32, wherein input end of the delivery optical fiber has a

2 diameter of less than 500 microns.

1 35. The laser system of claim 33, wherein the firing end of the delivery optical fiber has a

2 diameter of 300 micron or less.

1 36. The laser system of claim 32, wherein the firing end of the delivery optical fiber has a

2 diameter in a range of 50 to 225 micron.

3 37. The laser system of claim 32, wherein the guide structure is a tubular housing structure
4 that is bent at an angle between 0 to 90 degrees.

1 38. The laser system of claim 32, wherein the delivery optical fiber is a side firing optical
2 fiber.

1 39. The laser system of claim 32, wherein the guide structure further comprises a shield
2 member extending in front of a portion the firing end of the delivery optical fiber for
3 blocking laser light emitted from the firing end at angles other than the preferred angles.

1 40. The laser system of claim 39, wherein the means to generate bursts of laser light
2 comprises an Er:YAG laser medium.

1 41. The laser system of claim 32, wherein means to generate bursts of laser light is
2 configured to provide between 5 and 200 mJ/per pulse.

1 42. The laser system of claim 32, wherein the means to generate bursts of laser light is
2 configured to generate laser pulse with a repetition rate between 40 and 10 Hz.

1 43. The laser system of claim 32, wherein the means to generate bursts of laser light is

2 configured to generate a burst of laser light that are separations of less than 2.0
3 milliseconds.

1 44. The laser system of claim 32, wherein the means to generate bursts of laser light is
2 configured to generate 1-20 laser pulses for each laser burst.

1 45. The laser system of claim 44, wherein means to generate bursts of laser light is
2 configured to generate the laser pulses at pulse separations of less than 2.0 milliseconds.

1 46. The laser system of claim 32, wherein the delivery optical fiber is selected from the group
2 consisting of a fused silica fiber and sapphire fiber.

1 47. The laser system of claim 32, wherein the trunk fiber is a sapphire optical fiber.